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Medium run effects of short run inflation surprises: monetary policy credibility and inflation risk premium

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Medium Run Effects of Short Run Inflation Surprises: Monetary Policy Credibility and Inflation Risk Premium

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Abstract

First we show that Brazil is one of the few countries in which short run inflation surprises affect medium run inflation expectations. This phenomenon leads to a less effective monetary policy, as its output cost is higher. This is a symptom of at least one of two problems: (i) Inflation inertia / indexation of the economy; and/or (ii) Lack of credibility of the monetary authority. The remedy depends on the cause. For instance, if the reason is simply indexation, central bank independence will not solve it. We present a model arguing that we can identify if credibility is one of the causes by looking at the inflation risk premium. We show that this is the case in Brazil and, thus, central bank independence should helps monetary policy to be significantly less costly.

1 Introduction

For some time now the most popular subject among macroeconomist in Brazil is the inflation resilience to the high interest rate. Many possible reasons have been raised: fiscal dominance, lack of sensitivity of the National Development Bank's (BNDES) loans rate to the short rate determined by the monetary authority, fiscal policy not being contractionary enough, the short run expansionary effect of the expansion of the credit to consumers and so on. On this paper we point out that, in Brazil, credibility of the monetary authority is also an important factors clogging the transmission channels of monetary policy.

First, on an international comparison, we show that Brazil is one of the few countries in which short run inflation surprises affect medium run inflation expectations. This is a symptom of at least one of two problems: (i) Inflation inertia / indexation of the economy; and/or (ii) Lack of credibility of the monetary authority. The remedy depends on the cause. For instance, if the reason is simply indexation, central bank independence will not solve it.

We present a model arguing that we can identify if credibility is one of the causes by looking at the inflation risk premium. Then, we show that this is the case in Brazil. Thus, central bank independence should helps monetary policy to be significantly less costly. Other evidences points in this direction as only bad news (positive inflation shocks) seems to have some effect on both medium run inflation expectation and inflation risk premium.

Section 2 present the empirical evidence with a regression analysis of the effects of short run inflation surprises in 12 month inflation expectations on Brazil and the world as well as the evidence that for Brazil, inflation risk premium is very sensitive to inflation surprises. The asymmetry of positive and negative shocks is observed through all the empirical analysis. The theoretical model is presented in section 3. Section 4 concludes and provides some conjectures on the causes of the lack of credibility.

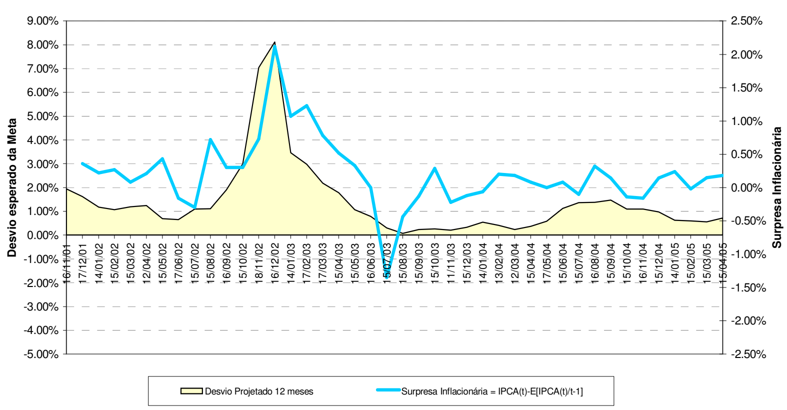
2 Empirical Patterns

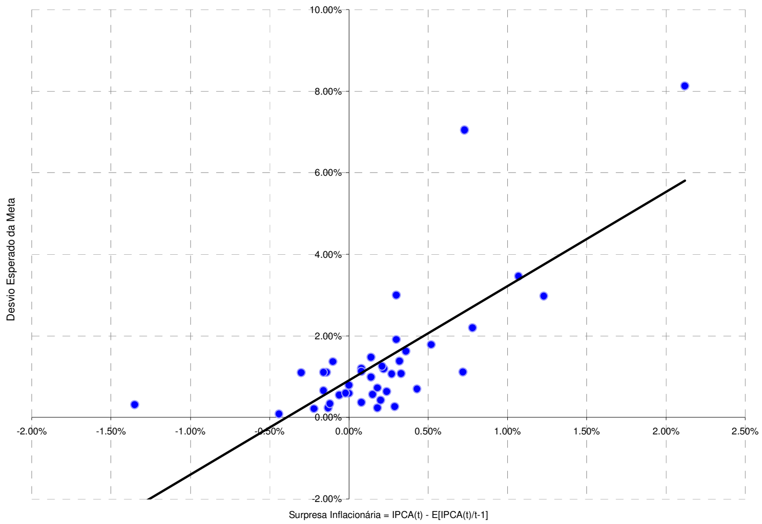
2.1 The Effect of Short Run Surprises in Medium Run Inflation Expectations in Brazil and the World

What is the effect of short run inflation surprises on medium run inflation expectations? We proceed in an empirical investigation to estimate this effect. We work on a monthly basis, on the coming notation, each t represents a month. Define:

- "Inflation Surprise" $= CPI_t - E_{t-1}(CPI_t)$
- "Inflation Gap" $= E_t\left(\sum_{s=t+1}^{t+12} CPI_s\right) -$ (Central Bank Anounced Target for 12months ahead).

We begin with the Brazilian data. One month ahead and twelve months ahead inflation expectations were collected from Brazilian Central Bank's Focus. On the graph and tables below, we present the results for Brazil:





Variável dependente: Desvio da Meta 12 meses = E(IPCA 12 meses) - Meta 12 meses

	Sample (adjusted): 2001M12 2005M04		Sample (adjusted): 2002M01 2005M04		Sample (adjusted): 2001M12 2005M04		Sample (adjusted): 2002M03 2005M03	
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
C	0.004157	*0.0531*	0.004141	*0.0629*	0.004144	*0.0641*	0.003791	*0.0958*
DESVIO(-1)	0.529557	*0.0007*	0.535157	*0.0009*	0.523073	*0.0011*	0.585586	*0.0004*
SURPRESA	1.064562	*0.0216*	1.055992	*0.0270*	1.128314	*0.0200*	0.867386	*0.0704*
D(LOG(CAMBIO(-1)))	-	-	0.005247	*0.8183*	-	-	-	-
D(LOG(CAMBIO))	-	-	-	-	0.015109	*0.5160*	-	-
LOG(CAMBIO/CAMBIO(-4))	-	-	-	-	-	-	0.022799	*0.0555*
R-squared	0.669818		0.670546		0.672638		0.705531	
Adjusted R-squared	0.65244		0.643092		0.645357		0.678761	
S.E. of regression	0.009553		0.009802		0.009752		0.009651	
Sum squared resid	0.003468		0.003459		0.003424		0.003074	
Log likelihood	134.0671		130.3583		130.5612		121.3222	
Durbin-Watson stat	1.328888		1.376169		1.301655		1.466368	
Mean dependent var	0.013846		0.013788		0.014013		0.0141	
S.D. dependent var	0.016205		0.016407		0.016376		0.017027	
Akaike info criterion	-6.393516		-6.317914		-6.328062		-6.341742	
Schwarz criterion	-6.268133		-6.149026		-6.159175		-6.167589	
F-statistic	38.54398		24.42391		24.65663		26.3554	
Prob(F-statistic)	0		0		0		0	

The evidence shown above is that short run inflation surprises induce a significant variation on medium run inflation expectation in Brazil, even when we control for exchange rate effect. On the table below we higlight two interestign features (1) only bad news (positive inflation surprises) seem to matter; (2) the expected component of the current inflation seem to have no effect at all on the 12 month ahead inflation gap.

Desvio da Meta 12 meses

	Sample (adjusted): 2001M12 2005M04	
	coefficient	p-value
C	0.006418	*0.0184*
DESVIO(-1)	0.446489	*0.1544*
SURPRESAPOS	2.379026	*0.0000*
SURPRESANEG	-0.411412	*0.0560*
EIPCA1MES(-1)	-0.010437	*0.0079*
D(LOG(CAMBIO(-1)))	-0.007996	*0.4605*
R-squared	0.821569	
Adjusted R-squared	0.794534	
S.E. of regression	0.007518	
Sum squared resid	0.001865	
Log likelihood	138.6466	
Durbin-Watson stat	2.453876	
Mean dependent var	0.013956	
S.D. dependent var	0.016586	
Akaike info criterion	-6.802389	
Schwarz criterion	-6.546457	
F-statistic	30.38916	
Prob(F-statistic)	0	

For sake of comparison, we implement similar analysis with international data. Since we do not have the same disagregation available for Brazil in international data, the analysis is slightly different. Instead of using short run infation surprises directly, we assume that the 1 month ahead inflation expectation is current month inflation, i.e., agents make projections as if monthly inflation was a random walk. We also modify the dependent variable, instead of using the the "inflation gap" we simply use the 12 month ahead inflation expectation, since some of the countries didn't have an announced target on our sample. We used are the market expectations survey and their sources are each country's central bank. To correct for endogeneity of the 12 month expected inflation and current inflation, we also run an instrumental variable regression where we use the lagged first difference of inflation as an instrumento to the inflation surprise. The results are shown below:

Dependent Variable: D(EXP12M)
Method: Least Squares

	CHILE		BRAZIL		TURKEY		UK		MÉXICO		ISRAEL	
	Sample (adjusted): 2001M10 2004M10		Sample (adjusted): 2002M01 2005M03		Sample (adjusted): 2001M10 2004M11		Sample (adjusted): 1997M10 2003M12		Sample (adjusted): 2001M06 2004M09		Sample (adjusted): 1992M02 1996M01	
	Included observations: 37 after adjustments		Included observations: 39 after adjustments		Included observations: 38 after adjustments		Included observations: 75 after adjustments		Included observations: 40 after adjustments		Included observations: 48 after adjustments	
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
C	-0.000356	0.9903	0.023606	0.8853	-0.857702	0.0106	-0.00621	0.7292	-0.085886	0.054	-0.138724	0.3974
D(INFLA)	0.027901	0.4789	0.501285	0.0617	0.332734	0.0837	0.027315	0.4164	-0.016286	0.8458	-0.359343	0.061
D(LOG(CAMBIO(-1)))	2.582692	0.0145	2.701295	0.1361	8.221259	0.0719	-1.416483	0.1776	2.308286	0.1997	15.90476	0.0121
D(LOG(COMMODITIES(-1)))	-1.494062	0.0412	-0.789851	0.7919	-13.87044	0.2256	0.65042	0.1771	1.161813	0.269	-7.47215	0.5032
R-squared	0.218647		0.177809		0.218647		0.063742		0.095636		0.123141	
Adjusted R-squared	0.149705		0.107336		0.149705		0.024182		0.020272		0.063355	
S.E. of regression	1.415401		0.71565		1.415401		0.154441		0.185942		0.894457	
Sum squared resid	68.1142		17.92541		68.1142		1.693504		1.244685		35.20231	
Log likelihood	-65.00806		-40.18042		-65.00806		35.73042		12.64239		-60.66691	
Durbin-Watson stat	1.341708		1.323522		1.341708		2.028508		1.870491		1.11265	
Mean dependent var	-0.947368		0.02		-0.947368		-0.004		-0.0665		-0.070125	
S.D. dependent var	1.534951		0.757454		1.534951		0.156343		0.187856		0.924212	
Akaike info criterion	3.632003		2.265663		3.632003		-0.846145		-0.43212		2.694454	
Schwarz criterion	3.80438		2.436284		3.80438		-0.722545		-0.263232		2.850388	
F-statistic	3.17143		2.523062		3.17143		1.611258		1.268993		2.059695	
Prob(F-statistic)	0.036599		0.073589		0.036599		0.194397		0.299605		0.11933	

Erro Padão estimado pelo método Newey-West

Dependent Variable: D(EXP12M)
Method: Least Squares

	CHILE		BRAZIL		TURKEY		UK		MÉXICO		ISRAEL	
	Sample (adjusted): 2001M10 2004M10		Sample (adjusted): 2002M01 2005M03		Sample (adjusted): 2001M10 2004M11		Sample (adjusted): 1997M10 2003M12		Sample (adjusted): 2001M06 2004M09		Sample (adjusted): 1992M02 1996M01	
	Included observations: 37 after adjustments		Included observations: 39 after adjustments		Included observations: 38 after adjustments		Included observations: 75 after adjustments		Included observations: 40 after adjustments		Included observations: 48 after adjustments	
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
C	0.000275	*0.9924*	0.0369133	*0.8238*	-0.9031188	*0.0120*	-0.0035178	*0.8397*	-0.0863169	*0.0518*	-0.1637156	*0.3222*
D(INFLA(-1))	0.0633989	*0.3253*	0.5213619	*0.0223*	-0.043515	*0.8659*	-0.0017427	*0.9354*	-0.0515741	*0.4203*	0.1429904	*0.4923*
D(LOG(CAMBIO(-1)))	2.1412376	*0.0271*	3.4282796	*0.1083*	8.8298457	*0.0592*	-1.2000911	*0.1280*	2.4876646	*0.1579*	15.979138	*0.0287*
D(LOG(COMMODITIES(-1)))	-1.6111915	*0.0201*	-1.7598839	*0.6275*	-13.069899	*0.1615*	1.5538316	*0.1123*	1.073216	*0.3291*	-3.5902507	*0.7343*
R-squared	0.2562016		0.1893343		0.1663264		0.1012891		0.1053712		0.0834617	
Adjusted R-squared	0.1885835		0.1198486		0.0927669		0.0633154		0.0308188		0.0209705	
S.E. of regression	0.1651627		0.7106161		1.462022		0.151313		0.1849389		0.9144702	
Sum squared resid	0.9001971		17.674135		72.675279		1.6255883		1.2312866		36.795256	
Log likelihood	16.246373		-39.905144		-66.239552		37.265299		12.858856		-61.729079	
Durbin-Watson stat	1.4380691		1.1456455		1.3936799		2.0751148		1.832076		1.110601	
Mean dependent var	-0.0162162		0.02		-0.9473684		-0.004		-0.0665		-0.070125	
S.D. dependent var	0.1833538		0.7574542		1.5349508		0.1563434		0.1878563		0.9242122	
Akaike info criterion	-0.6619661		2.2515459		3.6968185		-0.8870746		-0.4429428		2.7387116	
Schwarz criterion	-0.4878128		2.4221676		3.869196		-0.7634753		-0.2740548		2.8946451	
F-statistic	3.7889528		2.7247971		2.2611154		2.6673491		1.4133845		1.3355744	
Prob(F-statistic)	0.0193467		0.0589001		0.0990347		0.0541899		0.254742		0.2749977	

Erro Padão estimado pelo método Newey-West

The results showed on the tables above suggest that in Brazil and Turkey[1] this effect is positive while in Chile, UK, Mexico and Israel there is no effect at all. This phenomenon is deleterious, since output cost of monetary policy should be higher in those countries. We turn now to the question of what could be their causes.

2.2 Inflation Surprises and Inflation Risk Premia

Thus, the evidence above is that short run inflation surprises induce a significant variation on medium run inflation expectation in Brazil, differently from other countries. We conjecture that this phenomenon can be happening for two (non mutually exclusive) reasons:

- Indexation of the economy.
- Lack of credibility of the Central Bank.

It is pretty hard to argue that there is no remainig indexation in Brazil, as can be ilustrated by looking at the telephony and energy contracts. What we are interested in is in knowing if the lack of credibility makes the situation worse. If so, the benefit of an independent Central Bank would be even bigger.

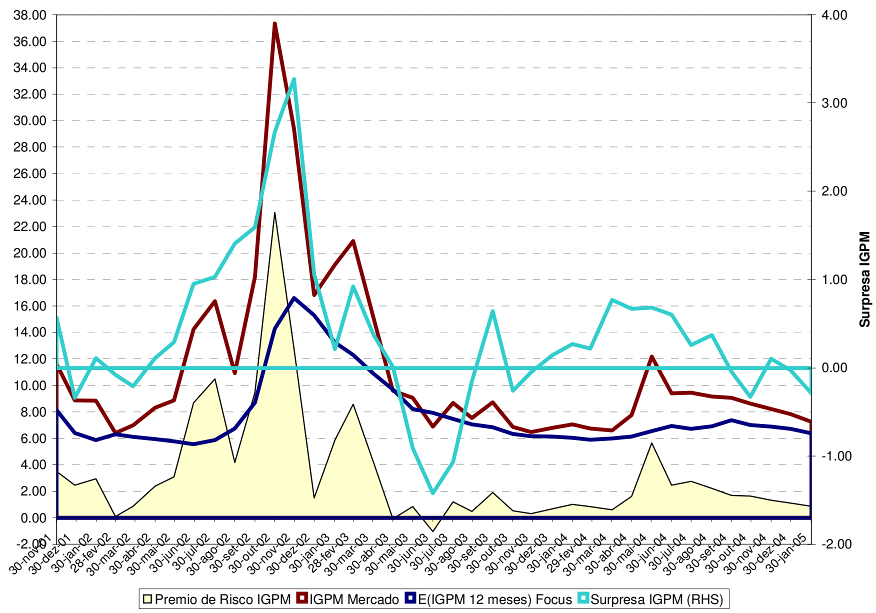
We propose a methodology to identify if the phenomenon itself is somehow related to the lack of credibility of the Central Bank and we make an aplication of it to the brazilian data[2]. The idea is to look at the *"Inflation Risk Premium"*, which is the difference between the inflation implicit in financial securities and the pure inflation expectation.

- "Market Inflation" $\simeq$ (Nominal Rate) - (Real Rate)
- Inflation Risk Premium $\simeq$ (Market Inflation) - (Expected Inflation)

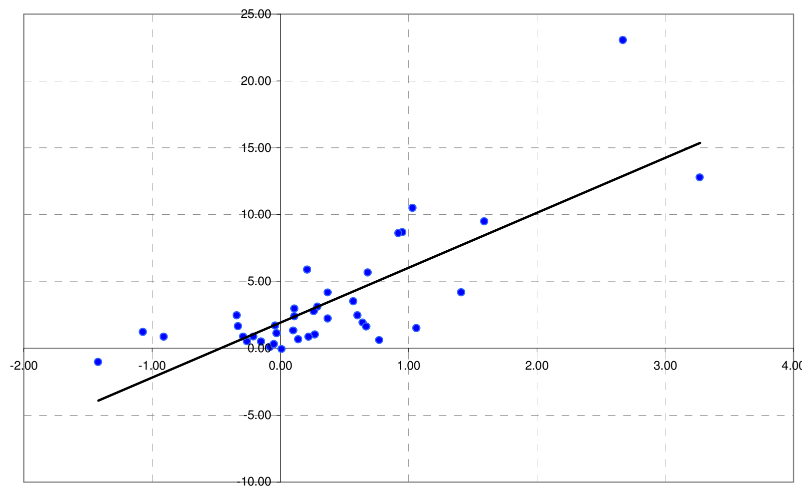
[1] In Turkey the effect is not observed when we run the instrumental variable regression.

[2] We have no doubts that the remainig indexation is very important in Brazil, specially the one presented on telephony and energy prices that depend on the past CPI and WPI. But the point is: Does the lack of credibility makes the situation worse? If so, the benefit of an independent Central Bank would be even bigger.

In the model presented in the next section, we argue that if the cause of the phenomenon is purely an indexed economy, there would be no reason for the inflation risk premium to be correlated with short run inflation surprises. On the other hand, if there are doubts about the future behavior of the monetary authority, concerning its interest rates response to inflation shocks, we should observe a strong positve relation between *Inflation Risk Premium* and *Short Run Inflation Surprises*. The aim of the model introduced later is to formalize this argument. But first, we look at the empirical relation between inflation risk premia and inflation surprises in Brazil:



Surpresa IGPM vs. Premio de Risco IGPM



	Sample (adjusted): 2002M01 2005M01			
	Premio de Risco IGPM			
	coefficient	p-value	coefficient	p-value
C	2.129318	*0.0011*	1.294026	*0.0338*
AR(1)	-0.070961	*0.6634*	-0.264822	*0.0961*
SURPRESAIGPM	4.080157	*0.0001*	-	-
SURPRESA Positiva IGPM	-	-	6.134969	0
SURPRESA Negativa IGPM	-	-	0.482547	*0.7237*
D(LOG(CAMBIO(-1)))	12.40335	*0.0829*	11.17393	*0.0774*
R-squared	0.666897		0.74915	
Adjusted R-squared	0.636614		0.717793	
S.E. of regression	2.802954		2.470107	
Sum squared resid	259.2662		195.2457	
Log likelihood	-88.51907		-83.27253	
Durbin-Watson stat	1.709882		1.727339	
Mean dependent var	3.42973		3.42973	
S.D. dependent var	4.649777		4.649777	
Akaike info criterion	5.001031		4.771488	
Schwarz criterion	5.175184		4.98918	
F-statistic	22.02278		23.89153	
Prob(F-statistic)	0		0	

The coefficient on when we regress inflation risk premium on inflation surprises is significant and approximately equal to 4, even with the inclusion of controls such as the exchange rate. Notice that only positive inflation surprises (bad news) seems to be driving the inflation risk premia. Good news have no effect at all. We now turn to the derivation of the model that formalizes our argument.

3 Model

3.1 Asset Pricing, Taylor Rule and the Inflation Risk Premium

The main message of the model is the following: If the cause of the effect of short run inflation surprise on 12 month inflation expextation is solely indexation, there is no reason for an increase in uncertainty when the economy is hit by a positive inflation shock: we know that the prices will be readjusted in the future with certainty. However, if there is lack of credibility on monetary policy, there will be an increase in the uncertainty on future responses to inflation, leading to an increase in the uncertainty on inflation itself. This will be capture by the inflation risk premium. We now formalize this argument.

Take an economy with two assets: a nominal bond ($P_t^{\$}$) and a real bond ($P_t$). These bonds will be freely traded in the market. In order to price them, we will suppose two things: absence of arbitrage and complete markets.

The absence of arbitrage imply that there will be a strictly positive stochastic discount factor M_{t+1} such that for any stochastic *real payoff* X_{t+1} to be realized in $t+1$, its price in time t will be given by $P_t = E_t\left[M_{t+1}X_{t+1}\right]$. The complete markets hypothesis will imply that the stochastic discount factor that will be used to price any asset in this economy will be the same. In particular, the M_{t+1} used to price the real bond will be the same one used to price the nominal bond. So if the *nominal payoff of the real bond is* Π_{t+1} and the *nominal payoff of the nominal bond is* 1, their prices will be:

- Real Bond: $P_t = E_t\left[M_{t+1}1\right]$
- Nominal Bond: $P_t^{\$} = E_t\left[M_{t+1}\frac{1}{\Pi_{t+1}}\right]$

Nominal bonds compensates investors for inflation risk while the real bond does not, since its real payoff is independent of inflation. Notice that if $E_t\Pi_{t+1}$ > 1, then $P_t^{\$} < P_t$ or, in other words, the real rate will be smaller than the nominal rate.

The log real rate is $r_t \equiv -\ln P_t$ and the log-nominal rate is $r_t^{\$} \equiv -\ln P_t^{\$}$. As in Vasicek (1977) and many others, we can specify the short rate process, which is equivalent to specifying a process for the stochastic discount factor. Third and main hypothesis: this short rate process is defined by the Central Bank and that it can be characterized by state dependent "Taylor rule". This is also done in Ang and Piazzesi (2003) and Rudebusch and Wu (2004). Since the central bank is concerned with the inflation, M_{t+1} will be correlated with the contemporaneous inflation shock π_{t+1}.

$$
\begin{aligned}
P_t &\equiv \frac{1}{e^{r_t}} = E_t\left[M_{t+1}(\pi_{t+1})\right] \\
e^{r_t} &= \frac{1}{E_t\left[M_{t+1}(\pi_{t+1})\right]} \\
r_t &= -\ln E_t\left[M_{t+1}(\pi_{t+1})\right]
\end{aligned}
$$

If the central bank wants to fight inflation, he needs to raise interest rate when the economy receives a positive inflation shock, this means that the central bank's state-dependent Taylor rule must have $\frac{\partial M_{t+1}(\pi_{t+1})}{\partial \pi_{t+1}} < 0$ and the agents must believe it.

In a world of risk averse agents, what determines price is not only their expectations of future payoffs but also the variance and covariance of the payoff with relevant state variables. Our task is to understand what affect the inflation risk premium, which is defined by the difference between the log "market inflation" ($\log \Pi_{t+1}^{market}$), and the agent's log expected inflation ($\log E_t(\Pi_{t+1})$). The "market inflation" is simply the inflation rate implicit on the financial securities, and it can be measured by the nominal rate minus the real rate $r_t^{\$} - r_r = p_t - p_t^{\$}$. To calculate that, define $m_{t+1} \equiv \ln M_{t+1}$, $\pi_{t+1} \equiv \ln \Pi_{t+1}$ and suppose that M_t and Π_{t+1} are jointly lognormaly distributed. The price of the nominal bond will be given by:

$$p_t^{\$} = E_t\left(m_{t+1}\right) - E_t(\pi_{t+1}) + \frac{1}{2} Var_t\left(m_{t+1}\right) + \frac{1}{2} Var_t(\pi_{t+1}) - Cov_t(m_{t+1}, \pi_{t+1}) \tag{1}$$

And the price of the real bond will be given by:

$$p_t = E_t\left(m_{t+1}\right) + \frac{1}{2} Var_t\left(m_{t+1}\right) \tag{2}$$

To calculate the inflation risk premium we also need the expected log inflation that under the lognormality assumption is given by:

$$\log E_t(\Pi_{t+1}) = E_t(\pi_{t+1}) + \frac{1}{2} Var_t(\pi_{t+1}) \tag{3}$$

So now we are ready to calculate the inflation risk premium substituting out the equations (1), (**??**) and (3) on the following definition we find :

$$\begin{aligned} \textit{Inflation Risk Premium}_t &\equiv \log \Pi_{t+1}^{market} - \log E_t(\Pi_{t+1}) \\ &= p_t - p_t^{\$} - \log E_t(\Pi_{t+1}) \\ &= Cov_t\left(m_{t+1}, \pi_{t+1}\right) \end{aligned} \tag{4}$$

Now we can easily see that if the CB is expected to raise real interest rates when the economy is hit by a positive inflation shock[3], i.e., if it the CB is expected to have a tight monetary policy ($Cov_t(m_{t+1}, \pi_{t+1}) < 0$) the inflation risk premium will be diminished. Equivalently, if the CB is expected to have a loose monetary policy ($Cov_t(m_{t+1}, \pi_{t+1}) > 0$), the inflation risk premium will be higher. In other words, what determines the inflation risk premium is the expected future Taylor rule.

[3] Recall that a higher interest rate means a lower stochastic discount factor.

3.2 What is the responsible for the correlation of inflation surprises with risk premium: Inflation inertia (indexation) or Monetary Policy Credibility?

What could be generating the empirical regularity in Brazil documented last section? To answer that, we will need to further parametrize the model. We start with the Taylor rule. The idea is to have a rule as general as possible, so that it can represent many kinds of central bank. Define $\varepsilon_t^\pi \sim N(0,\sigma)$ as the unexpected inflation shock at time t. We will allow the central bank to respond to contemporaneuos or any past shock, with different elasticities of response. The state-dependent Taylor Rule is given by:

$$m_t = \overline{m} + \theta_0 \varepsilon_t^\pi + \theta_1 \varepsilon_{t-1}^\pi + \theta_2 \varepsilon_{t-2}^\pi + ... \tag{5}$$

Where $\overline{m}$ is the long run "natural" stochatic discount factor, that will give the economy's long run natural interest rate. θ_j are the monetary policy response to inflation shock at time j. Since the real interest is given by $\frac{1}{E_{t-1}(M_t)}$, the harder the response of the central bank to the inflation shocks, the smaller the θ. Each "type" of Central Bank will choose its $\theta' s$ according to its preferences concerning inflation (and GDP). We will come back to this issue later because first we need to model the inflation's dynamic. Assume that the log inflation is given by:

$$\pi_t = (1-\phi_\pi)\mu_\pi + \phi_\pi \pi_{t-1} + \phi_m (m_{t-k} - \overline{m}) + \varepsilon_t^\pi \tag{6}$$

Where, μ_π is the long-run "natural inflation"; ϕ_π is the inflation inertia (degree of indexation of the economy); ϕ_m is the inflation sensitivity to monetary policy that is typically bigger than zero. ε_t^π is the inflation shock at time t and; k is the lag with which the monetary policy affects the economy.

Should the monetary authority react to current inflatio shocks ε_t^π raising interest rates if it wants to diminish inflation, i.e., should $\theta_0 < 0$? If the $k = 0$ the answer is clearly yes. But it is also easy to see that even if the monetary policy affect the economy with some lag ($k > 0$), the central bank will want to have $\theta_0 < 0$ if we have some inflation inertia ($\phi_\pi > 0$). Now we can have a clearer expression to equation (4):

$$\begin{aligned} \textit{Inflation Risk Premium}_t &= \theta_0 \sigma_{t+1}^\pi (1+\phi_m) \text{ if k=0} \\ &= \theta_0 \sigma_{t+1}^\pi \qquad\qquad \text{ if k} > 0 \end{aligned} \tag{7}$$

This is enough to see that indexed economy does not provoke a positive correlation between inflation surprises and inflation risk premium, since the indexation parameter ϕ_π does not appear in equation (7). What is necessary is that positive inflation shocks induce a change on the perceived θ_0, the covariance between the stochastic discount factor and the inflation shocks. In the model presented above, this covariance is the expectation of the response of future monetary policy to inflation shocks.

Another possibility for time-varying risk premium is the presence of heteroskedasticity in inflation. But even if the stochastic process of inflation were heterosketestic (for example an ARCH process), we should not observe a correlation between inflation surprises and inflation risk premium. This is so because even under a ARCH process, a positive shock would have the same effect as a negative on next period inflation volatility. All that matters is the absolute value of the shock. Indeed, as shown last section, on the Brazilian data when, the coefficient on the positive surprise is significant (and much larger in magnitude than before) while the negative surprise is not statistically significant.

Therefore, what is happening in the Brazilian data is that on the presence of positive unexpected inflation shocks the agents fear that the "type" θ_0 of the monetary policy could change. Precisely, agents are fearing a loosening of monetary policy $\theta_0^{'} > \theta_0$ when the economy is hit by a positive inflation shock. This has a deleterious effect on economy since the inflation expectations should also increase on the presence of this shock, making monetary more costly in terms of output loss. It should be clear that we are not saying that lack of credibility of the monetary policy is the only factor: inflation indexation can be important too (and we think it is, as the examples of the public services contracts such as telephones and energy points out). But the empirical evidence and the model developed above show that credibility is also an important part of the problem. Thus, in Brazil, there is room to reduce the cost of monetary policy by promoting Central Bank independence.

4 Conclusion

On this paper we argue that an additional factor that can helps to explain the low efficiency of monetary policy in Brazil is the credibility. Although interest rates are very high in the present, what determines the agent's price setting is the expectation of what is going to happen in the future. If people think that the current tight monetary policy can be relaxed in the future, they will resist setting their prices according to the announced targets.

In fact, first we show that Brazil is one of the few countries in which short run inflation surprises affect medium run inflation expectations. This phenomenon leads to a less effective monetary policy, as its output cost is higher. We conjecture that this is a symptom of at least one of two problems: (i) Inflation inertia / indexation of the economy; and/or (ii) Lack of credibility of the monetary authority.

The remedy depends on the cause. For instance, if the reason is simply indexation, central bank independence will not solve it. We present a model arguing that we can identify if credibility is one of the causes by looking at the inflation risk premium. Then we also show that this is the case in Brazil as we find a very strong relation between short run inflation surprises and inflation risk premium. It is also striking that the only bad news on short run inflation seems to have effect both on 12 month inflation expectation and on inflation risk premium. Thus, we conclude that this evidence points out that central bank independence should helps monetary policy to be significantly less costly.

We conjecture that this lack of credibility cannot be understood looking at the history of very conservative decisions of the Brazilian central bank on our sample. We believe that what harms its credibility is the fear of regime switch (peso problem). This could happen either for a political reason, or by a financing constraint. The reasoning of the political economy is story goes as follows: bad news on inflation would require an even tougher monetary policy, reducing the chance of reelection of the incumbent party. In such a scenario, constantly arriving of good news would be necessary to prevent a regime switch and that's why bad news would have such a deleterious effect. Alesina, Roubini and Cohen (1999) survey this literature. Another possibility, as proposed by Blanchard (2004), is that fiscal dominance could induce to a monetization of the government debt in the future, therefore, increasing inflation. Perceiving that, agents would adjust their expectation today when a negative shock hits the economy.

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